

higher value 542', and resecure the far end of link arm 528 as depicted in Fig. 5A. If desired, the apparatus at Fig. 5 can be adjusted so that the footcars 50 move along a track which is angled downward toward the front of the machine (to simulate declined skiing situations).

5           When the device of Fig. 5 is set at an inclination 542 up to about 10°, it is anticipated that users will typically employ the arm ropes 75. At inclinations greater than about 10°, it is anticipated that users may prefer to use the rail system 77, 79. The rail system is believed to offer an upper body exercise similar to using a pair of banisters when climbing stairs.

10           As discussed above in connection with Figs. 1 through 4, a variety of mechanisms can be used to sense the position and/or movement of the user along the fore-aft axis of the machine and to control speed, in response. In the embodiment of Fig. 5, similar devices can be used for sensing fore-aft position of the exerciser. In the embodiment of Fig. 5, it is preferred to use the position of the user to control the speed with which the belt 52 moves, e.g., by controlling the speed of the motor 53. For example, the speed of the motor 53 may be controlled by  
15 a motor speed potentiometer whose setting is determined by an arm coupled to a line or cable. Thus, whereas in the embodiments of Figs. 1 through 4, pulling on a line 34, 39 resulted in tightening a friction band 14, in the embodiment of Fig. 5, pulling on a similar line in response to the fore-aft position of the exerciser moves a potentiometer arm so as to change the motor speed 53. Thus, as the user moves forward on the machine of Fig. 5, the potentiometer is preferably moved so as to increase the speed of the motor 53, and when the user moves  
20 backward, towards the rear of the machine, the potentiometer is moved to a position so as to decrease the speed of the belt 52. In the embodiment depicted in Fig. 5, rather than sensing the position of the user via a clothing clip or differential motion sensor, a sonar transducer is mounted to the upright frame 67 preferably at a height approximately near the user's abdomen to measure his or her distance from the front of the machine. In one embodiment, a microcontroller is used to operate the motor speed based on inputs from the transducer, e.g.,  
25 according to the scheme depicted in Fig. 10, discussed more thoroughly below. A number of sonic transducers can be used for this purpose, including model part #617810 available from Polaroid.

As depicted in Fig. 6, the footcar 50 has a generally inverted U-shape configured to fit over the top of a rectangular tube section 60. The rectangular tube section 60 includes longitudinal slots 612a, 612b which  
30 accommodate the axles 63a, 63b of the footcar. The axles 63a, 63b extend through the footcar axle bearings 614a, 614b, 614c, 614d and through the slots 612a, 612b as the footcar 50 moves forward 512 and aft 514 over the square tube 60. Interior to both the footcar 50 and the square tube 60, the axles 63a, 63b bear footcar wheels 49a, 49b, 49c, 49d. Each of the wheels 49a, 49b, 49c, 49d are configured with a one-way clutch, as described above, such that the wheels 49a, 49b, 49c, 49d roll freely in a first direction 616 but are locked against rotation in the  
35 opposite direction 618, when the footcar 50 is moving aft 514. A conveyor belt 52 is positioned in the interior of

the square tube 60 with the bottom surfaces of the footcar wheels 49a, 49b, 49c, 49d contacting the inner surface 622 of the lower limb of the conveyor belt 52. The rear end of the conveyor belt 52 is retained by conveyor belt idler 59 held by an idler retainer 58 and backer plate 57. An adjustable screw 65 can adjust the fore-aft position of the idler retainer 58 to adjust the tension on the belt 52. The fore end of the belt 52 passes around the conveyor belt drive roller 70 (Fig. 7) which is mounted on a drive shaft 83. Preferably the footcars 50 are configured to provide adjustable resistance when moving in the forward 512 direction (independently of the amount of perceived resistance in the reverse direction).

In the embodiment described above in connection with Figs. 1 through 4, it was described how it was possible to construct one-way forward leg resistance in connection with the one-way clutches 20a, 20b. In the embodiment of Figs. 5 and 6, it is also preferable to provide an amount of forward leg resistance and, if desired, a mechanism similar to that discussed above in connection with Figs. 1 through 4 can be used. In the embodiment of Fig. 6, friction pads 64a, 64b, 64c, 64d can be made to bear against the outside surfaces of the wheels 49a, 49b, 49c, 49d. In the depicted embodiment, the wheels 49a, 49b, 49c, 49d are free to move laterally 624 a certain amount. Thus, in one embodiment, when adjusting screw 61 is tightened, this screw presses against the outside of the friction pad 64b which in turn presses against the outside surface of the wheel 49b. A brake spring 62 pressing against the opposite side of the clutch 49 is provided to give increasing pressure against the tightening of the adjust screw 61, resulting in greater friction to the clutch in the free wheel direction 616.

Another embodiment is depicted in Figs 11 and 12. A pair of slidable footcars (of which only the left footcar 1102 is seen in the view of Fig. 11) is mounted on parallel tracks (of which only the upper surface of the left track 1104 is seen in the view of Fig. 11). Although the tracks can be configured to provide a constant separation, such as a separation of about 12 inches (about 30 cm), the apparatus can also be configured to provide adjustable separation, e.g. via a rack and pinion mounting (not shown). The tracks are long enough to accommodate the full stride of the user, normally about 30 inches to 50 inches (about 75 cm to 125 cm).

The cars 1102 are designed to slide or travel linearly up and down 1106 the tracks. In the depicted embodiment, the cars travel on the tracks 1104 supported by wheels 1108 a,b which are configured to maintain low rolling resistance to the tracks while carrying the full weight of the user.

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A cable or belt 1110 attaches to the back of each car 1102 and extends in a loop over rear pulley 1112 and front pulley with integral one-way locking mechanism 1114, to attach to the front of the car 1102. The integral one-way locking mechanism of the front pulley can be, for example, similar to that used for the one-way clutches 20a,b of the embodiment of Fig. 2. In the depicted embodiment, the front pulley 1114 and a speed controlled flywheel 1116 or motor (not shown) are mounted on (or coupled to) a common drive axle 1118. The flywheel may

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be mounted on the drive axle in a fashion similar to that described for mounting a flywheel on shaft 35 in the embodiment of Fig. 2. Preferably, the cable or belt is designed to grip the front pulley 1114 such that there is little or no slippage between the cable 1110 and the pulley 1114, even under load. In one configuration, the belt 1110 is a geared belt of the type used for a timing belt (e.g. a nylon belt) with mating cogs being provided on the forward pulley 1114.

As depicted in Fig. 12, each forward pulley 1114a,b is configured with a one-way friction mechanism 1124a,b. The one-way locking mechanism and one-way friction mechanism are configured such that when a car 1102 is moved in rearward direction, the locking mechanism 1124 engages and spins the drive axle 1118, driving the flywheel 1116. When a car 1102 is moved in the forward direction, the one-way locking mechanism 1124 releases and the one-way friction mechanism 1122 causes a rearward force on the car 1102 transferred from the momentum of the moving flywheel 1116 or motor force. The intensity of the one-way friction mechanism 1122 can be made adjustable (such as by adjusting the force of springs 1121a,b and, thus, washers 1122a,b on the friction pads 1124a,b) or kept at a fixed level. The inclination of the tracks can be varied, as described for other embodiments herein. Arm exercise mechanisms can be coupled to the drive shaft as described for other embodiments herein.

Figs. 7 through 9 also depict an arm exercise mechanism. In the depicted embodiment, an upright frame element 67 accommodates left and right ropes 812, 814. A first end of rope 812 is coupled to a left hand grip 75a. The rope 812 then is positioned over a first fixed pulley 816a, over a second movable pulley 818a, (coupled to arm line 68a) to a second fixed pulley 822a and thence coupled to a rail hand grip 77a configured to slide along rail 79a. As can be seen in Fig. 8, a similar arrangement is provided for the right rope 814. If the machine is declined 545, it is anticipated that the user will typically use the hand grips 75a, 75b rather than the rail grips 77a, 77b.

The arm exercise lines 68a, 68b are wrapped around spools 72a, 72b coupled by one-way clutches 712a, 712b to the driveshaft 83. A number of one-way clutches can be used for this purpose, including clutches similar to those 20a, 20b used in connection with the driven rollers 116a, 116b. The spools 72a, 72b are coupled by the clutches 712a, 712b to the driveshaft 83 in such a manner that unwinding either of the ropes 68a, 68b by pulling on the hand grips 75a, 75b, 77a, will cause the clutch to engage and lock against the shaft 83 in the same direction that the shaft is spinning the belt drive rollers 70. A pair of recoil springs 71a, 71b retract the ropes 68a, 68b onto the spools 71a, 71b when the user relaxes tension on the ropes 68a, 68b.

By pulling on either end of the ropes 812, 814, i.e., by pulling on hand grips 75a, 75b or rail grips 77a, 77b, the movable pulleys 818a, 818b are, respectively, pulled upward, unspooling lines 68a, 68b from the spool 72a, 72b such that the user perceives resistance to pulling on the handle 75, 77 (greater than internal or friction